Why we should not abandon conceptualization of discovery and creativity?[1]

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Discovery and creativity are still surrounded by many mysteries. Are discovery and creativity things that cannot be understood with conceptual means? If there were some method for generating new things, would it not mean that the results in a genuine way, lacked creativity or novelty? Perhaps creativity is something which is well described by a famous statement attributed to a jazz musician, Humphrey Lyttelton, when asked about the future direction for jazz: "If I knew where jazz was going I'd be there already". It seems that what is genuinely new is essentially something which contradicts that which existed before and also which we have been able to expect and anticipate. A classic Meno paradox applies generally to making inquiries; how can we start making research on something which does not yet exist (Plato, Meno 80d-e)?

Margaret Boden has noted that often creativity is even defined so that it seems to be almost something impossible or "godlike"; creativity is then understood so that something *totally* new is generated; that is, from nothing, and without any antecedents (Boden 2004, 11, 40). Various elements are also connected to discovery which seem to be contradictory with each other: Discovery means that one can break previous ways of understanding things, but on the other hand, it seems to require strong knowledge of traditions.

[1] The title makes an allusion to Larry Laudan's (1980) well known and influential article in the philosophy of science: "Why was the logic of discovery abandoned?". In that article Laudan gave historical reasons (and as it seems: good reasons) why the area of discovery was abandoned in the philosophy of science. I am trying to show, however, that there are good reasons to take discovery as a key question in the philosophy of science (see in more detail Paavola 2006, especially pp. 19-32).

Discovery is often depicted as a sudden moment of insight or chances, but on the other hand it seems to require long-term work and purposefulness (it is often said that discovery requires more perspiration than inspiration). Individuals seem to be a central source of new ideas, but on the other hand what is new seems to be generated by a certain cultural period or interaction; models of discovery can emphasize observations as a starting point for inquiry, or on the other hand, emphasize that everything is "theory-laden". There are many such "essential tensions" related to discovery (see Paavola 2001).

The 20th-century philosophy of science generally fitted well with the picture described above. It was often thought that conceptual models cannot deal with discovery. It was maintained that, from the point of view of knowledge and science, it is not even important how something is discovered; it is only essential if the thing can be justified. According to the famous model of Karl Popper about the growth of scientific knowledge, science proceeds with conjectures and strict testing of these conjectures (e.g. Popper 1972). According to this approach scientists discover by chance (or by any other means) new ideas which are then tested or refuted. Popper himself compared this model to the Darwinian model of a natural selection. The Popperian model is in various ways criticized, but when it comes to discovery most 20th-century philosophers of science seemed to agree; there is no such thing as "logic of discovery" which would describe how new ideas are actually generated. Discovery is always something unique, unanticipated and has its basis in special talents of human beings.

Everyday thinking has also supported this kind of a view. Creativity and discovery are related to great "geniuses" who have exceptional skills or talents for creating something new. A basis for creativity is inborn gifts or some extraordinary talent, which originates in a creative act.

There are, however, many modern tendencies related to discovery and creativity which point to a different direction. Artificial intelligence, "intelligent" devices, especially new computer programmes which seem to do things which are traditionally considered to be difficult and requiring intelligence (like playing chess) have brought out the idea more strongly, especially in everyday thinking; Maybe creativity and discovery are still things which can be modeled with machines? If it is true that human beings may be considered as basically machines, then would it not be possible to have such logic of discovery, which would help to build some sort of "discovery machines"?

On the other hand, in public speeches it is often repeated (almost ritualistically) that modern life requires creativity and innovation. It is a common worry whether schools raise up creative thinkers and if one's nation or community is creative enough, or how to promote creativity. It seems that if there was previously a need for an emphasis on justification on the one hand, and for geniuses and the ideology for "great men" on the other hand (cf. Sawyer 2006, 259), now there is a need for understanding processes of creativity and how creative solutions are generated, both in everyday life, in working life and within more traditionally considered "creative" fields.

Abductive modeling of processes of discovery

My dissertation especially concerns processes of discovery within science. The subject of the thesis is an abductive form of reasoning first presented by Charles S. Peirce (1839-1914) already in the 1860s. Peirce also presented abduction as a way that hypotheses and ideas are generated. Peirce's abduction, as well as Peirce's theory of signs more generally, was *not,* for a long time, examined very much at all, or if it was, it was usually criticized. It seemed that Peirce presented abduction not just as a form of reasoning where

somehow surprising or anomalous phenomena are explained with candidate hypotheses, but also as some sort of an "instinct" for finding good ideas. But if the basis of abduction is this kind of an "instinct" can it be *reasoning*? And does it explain processes of discovery much, or is it really the same as saying that new ideas are a result of a mysterious process?

There have been also defenders of abduction. In the 1950s and 1960s N. R. Hanson tried to defend and develop – against main trends of his time – abduction as a "logic of discovery", that is, as a means of understanding conceptually how ideas are discovered and developed within science (e.g. Hanson 1958). Hanson's interpretation of abductive inference seems not to be adequate as a logic of discovery, but at most a logic for an appraisal *after* the idea or hypothesis is first generated --as a result of some unclear psychological process. This was, at least, how Hanson's formulations were criticized by many "friends of discovery". This label was given to philosophers of science, who around the 1980s, again brought forward discovery very strongly as a central subject area for philosophy. But the "friends of discovery" also had reservations when it came to the area of discovery in a "genuine" sense, and also about abduction as a model of discovery.

Abduction and discovery, as well as Peirce's theory of signs more generally, have started to interest researchers more in recent decades.[2] A Peircean way of understanding signs and logic seems to conform better with modern 21st-century conceptions of human action than 20th-century philosophy or ways of thinking.

In my thesis I develop abduction, first, as a form of reasoning, as a sort of "detective reasoning", where with the help of clues, various constraints and

[2] "Heuristic appraisal" of inquiry has become more and more important, not just "epistemic appraisal" if Thomas Nickles' apt terms are used here (see Nickles 1989).

"patterns" are searched for in order to solve some problematic situation. Former research has not sufficiently taken into account that ideas are sought for abductively by combining many inferential moves together, which means that in itself a very weak mode of inference -- a way of looking only for plausible possibilities – becomes stronger. In other ways, abductive inference should be seen and assessed as a part of a larger process of search for ideas and not as a separate inferential formula, as it has often been previously analyzed. Human beings are good at using various fine-grained bits of information and small clues as help when searching for as "lovely" and detailed candidate explanations as possible.

Secondly, I distinguish abductive inference and abductive "instinct" from each other. Peirce, especially in his later writings, combined these two, which has caused confusions. I maintain that an abductive "instinct" (i.e. a sort of an abductive "intuition") differs from the abductive inference because the abductive instinct has its basis on things which are not controlled by human beings in the same way as in reasoning. Peirce himself, interestingly, presented how human beings are able to solve problems and search for novel ideas with the help of clues which they are not able to consciously recognize. For example, Peirce described an event where he successfully operated as a detective when solving a theft of his own belongings. Non-conscious clues can also lead astray, but they are one central basis for the way human beings search for novel ideas.

Thirdly, I develop abduction as a part of socially, culturally, and materially distributed cognition. If the aim is to understand human problem solving in authentic environments, it should be taken into account that human beings do *not* develop their ideas alone, within their own heads, and without any instruments and aids simply by making inferences or by having insights. Rather, they do so by living and acting within some environment and by using culturally developed tools and knowledge; by developing ideas in

relation to conceptions presented by others and by doing things persistently and often within very long-term processes. Emblematically, in modern crime stories, crime scene investigators as groups of people with highly developed instruments have replaced solitary detectives like Sherlock Holmes. Peirce himself did *not* develop *abduction* in these directions although there are such elements in his general theories concerning inquiry and signs. The ideas of distributed cognition have not been explicitly developed until last two or three decades, so it is no wonder that this kind of an approach is new in relation to abductive methodology (see Magnani 2004).

In our own research group (Centre for Research on Networked Learning and Knowledge Building, University of Helsinki - www.helsinki.fi/science/networkedlearning) we have been developing a related "trialogical" approach to "knowledge creation" on the basis of various models and theories emphasizing *mediation* (Paavola & Hakkarainen 2005). This perspective is a work in progress, but, in any case, the focus is on those ways human beings collaboratively develop mediating "objects" and tools. A central issue is then not just activities or properties of individuals, nor just interaction between people or between people and their environment but the way people use and modify existing tools, models, concepts, etc. while developing something novel, and the ways such 'objects' influence human thought and activity. From this point of view, creativity does not just concern properties or skills of individuals or communities but also the shared objects -- problems, theories, models, plans -- which are developed. It is perhaps the case that, in discussing creativity, the focus should be more on those problems and artefacts which we should creatively develop, and not so much on how to promote creativity of individual human beings or communities (cf. "task involvement" – Gruber 1989a, 250). If a human being gets excited about some things he/she finds important and interesting, these things – at least partly – spur him-/herself to be creative; it is not just that creative people make these things.

Conceptualizing human creative actions with philosophical means

To do philosophy means that existing phenomena or an array of phenomena are problematized, and the aim is for conceptual understanding by capturing basic features of these phenomena. There are no a priori reasons why phenomena related to discovery and creativity could not be captured with conceptual means, but this requires that the conceptual equipment of philosophy be developed further in relation to the area of discovery. This does not remove mysteries surrounding discovery and creativity, at least not completely. Similarly to Hanson, I am developing abduction as a way to conceptually understand the area of discovery, *not* as a "discovery machine" or as an algorithm for producing discoveries.

One central driving force of the western culture seems to be an endless curiosity and the aim of trying to solve all kinds of mysteries. Processes of discovery are surely no exception. There are no guarantees that if we understand these processes better, that we would have only beneficial results in the long run. It might be that endless curiosity, attempting to understand and explain everything and trying always to do novel things are injurious to human beings. In any case, the development of abduction as such leads to emphasize things a basis for creativity according to fundamentally human capacities, like the ability to take minute things and clues into account, to follow one's inklings, to see connections, to delineate broad and "lovely" entities or patterns, to collaborate and to develop things with a long-term perspective.

A basis for discovery and creativity is not any single capacity of human beings, but it is surely always a wide array of capabilities which are also different within different areas of expertise. Still I think that there are some basic capabilities in relation to the behavior of human beings, which explain

the special nature of human action. Philosophy has traditionally tried to capture and understand this nature. Human beings are able to understand signs and meanings in a special way, and to be "intentional" creatures. Intentionality means that human beings are able to be purposeful, and that their activities are directed to some contents or objects. Intentionality is related to human ability to act in a goal-directed way. But also -- as Jaakko Hintikka has emphasized – intentionality means that human beings are able to consider several possibilities simultaneously ("intentionality as intensionality") (Hintikka 1975, 194-195). I think that this is a central basis for how humans are able to be cultural and social beings, to use language and solve problems – or, for example, to understand humour. This is also a central basis for abduction, that is, to be able (at least in principle) to take into account many possibilities simultaneously, and build hypotheses and ideas upon different possibilities.

The title of my thesis 'On the Origin of Ideas' is partly an allusion to Darwin's theory of evolution ('On the Origin of Species'), and to the epistemological model created later on as an analogy to it, that is, an evolutionary epistemology. In the natural selection variation caused by chance processes is a mechanism for generating novelty (if these variations survive). Also according to the abductive model, that which is novel is generated by mechanisms which are *close* to chance processes (and guessing). A difference from biological evolution is, however, that in creative activity of human beings, not even the radically new is generated by *pure* chance or guessing (at least, not basically so). A basis for abduction are clues and constraints; the situation is similar to the famous game of the 20 questions, where with good questions the aim is to determine what the other person is thinking. New, promising ideas are not generated from scratch, but by using and combining former solutions and elements in a new way and by developing these forward, often in very long-term processes.

In the beginning I mentioned some "essential tensions" which seem to be involved with understanding of discovery and creativity. I think that to understand creativity means using "both/and" thinking rather than choosing either of these extremes. The basis for creativity is *both* individuals *and* social and cultural factors; new ideas require *both* knowledge of the tradition *and* breaking of them, the starting point is *both* theories *and* observations, *both* long-term work *and* insights, etc. Peirce's broad theory gives a means for conceptualizing mediating factors between these elements.

How does one solve the challenge of the Meno paradox from the point of view of abduction? Can human creativity be directed to specific goals? Rather, is it not so that the genuinely new idea often surprises even its creator; that is, a goal cannot be known when something new is being developed (cf. Nickles 1997; Kleiner 1999)? Hintikka has paraphrased Picasso, who said "a creative artist does not seek: he find[s]" (Hintikka 1975, 196). Thus in a creative act, one cannot purposefully seek anything, but the new which is found is a surprise. I would say, however, that from the point of view of abduction, the creator of something new both finds (with surprises) and searches; creativity includes, strongly, both goals and chance events (see Gruber 1989a; 1989b)[3]. While searching, human beings often have at first a vague and partial goal in mind; the search might lead to directions which one did not, at the beginning, expect to be searching at all; but central elements for these new findings are provided by the previous goal.

On this basis, I find the allegory of Ludwik Fleck very apt in describing a process of discovery: Researchers and searchers of novel things share a path with Columbus; they are searching for their own "India" and are convinced that they are on the right track, but they might surprisingly discover some new "America". They undertake a voyage of not straight sailing to any planned direction, but an odyssey with changes of direction (Fleck 1979, 69).

[3] It is the same with human action in general.

I don't interpret this to mean that discovery is only about "happy guesses" ("serendipity"); rather plans, goals, and various clues guide human behaviour in creative activities. But while searching for new things, people are sensitive to changing their plans and searching a new direction. There is also a difference from Columbus' and Odysseus' journeys; the goal itself might be updated and changed during the journey while new clues come forward. Reason and unanticipated things do not exclude each other within abductive discovery and creativity.

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